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REPORT TO THE 1977 LEGISLATURE BY THE

CITIZEN'S ADVISORY COMMITTEE ON ENERGY

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REPORT TO THE 1977 LEGISLATURE BY THE CITIZEN'S ADVISORY COMMITTEE ON ENERGY

December 1976

TABLE OF CONTENTS

	Page
Introduction	1
Montana's Natural Gas Supply Crisis	1
The Problem	3
Conservation	5
The Technology of Coal Gasification	6
Montana's Alternative	8
Specific Legislative Proposals	11
An Energy Advisory Office for the State of Montana	11
Life Cycle Cost Analysis	12
Tax Incentives for Solar Energy	12
Building Codes	13
Home Weatherization	13
Education	13
Bottle Recycling	13
Appendix A	14
Appendix B	17
Appendix C	21

December, 1976

The Honorable Thomas L. Judge, Governor
Members of the Legislative Assembly
The People of Montana

The Citizen's Advisory Committee on Energy (CACE) herewith respectfully submits its report to the 1977 Legislature.

Governor Judge created the Citizen's Advisory Committee on Energy in early 1976 to more fully involve the people of Montana in government decision-making on energy issues. The Committee took as its first charge an analysis of forecasted natural gas shortages and a study of various alternative solutions to those shortages. This report summarizes the findings and recommendations of the Committee and its various subcommittees.

It is hoped that thorough consideration and implementation of the alternatives to coal gasification, which are presented in this report, can enable Montana to avoid future serious natural gas shortages.

Gene Mahoney
Chairman

Introduction

The Citizen's Advisory Committee on Energy (CACE) was named by Governor Thomas L. Judge in early 1976 and began formal meetings on March 2, 1976.

The Committee subdivided itself into various subcommittees, each of which investigated separate aspects of the problem of energy. This report is a synthesis of each subcommittee's work. The work of the Committee and its subcommittees involved collecting data, reading reports and consulting with various agencies, individuals and departments of state government. This report represents our findings.

The Committee took as its first charge an analysis of forecasted natural gas shortages and a study of various alternative solutions to those shortages. The Committee is indebted to other groups [e.g., Montana Energy Advisory Council (MEAC); Montana Energy and MHD Research and Development Institute (MERDI); the Governor's Coal Gasification Task Force (Montana International Trade Commission); and the Environmental Quality Council (EQC)] for information and advice, but was also fortunate in that its membership represented a wide cross-section of Montana citizens. Thus, some basic data and a great deal of input on an overall philosophy of meeting energy needs was available within the Committee.

This report has been prepared for the 1977 Legislature. It contains data on the gas supply crisis and projections of methods to meet that crisis. Emphasis is given to alternatives to coal gasification, particularly conservation and renewable energy sources. Legislation which would aid such alternatives is suggested.

Montana's Natural Gas Supply Crisis

For all uses, Montana consumes nearly 80 billion cubic feet of natural gas annually. Table 1 on the following page shows Montana's natural gas consumption by sector from 1950 to 1975.

Table 1

Montana Natural Gas Consumption by Major Sector
1950-1975 (billion cubic feet)

Year	Residential	Commercial	Industrial
1950	12.3	5.9	12.9
1955	15.4	8.7	17.6
1960	18.5	11.0	19.8
1965	22.6	14.4	28.0
1970	23.5	15.4	36.4
1975	26.3	17.6	32.6

Residential natural gas use, accounting for 34 percent of the state's total demand, is basically for space and water heating. Commercial natural gas use, amounting to 23 percent of total demand, is also predominantly consumed to provide space and water heating. Industrial natural gas use, about 43 percent of all gas demand, is used mostly as a boiler fuel.

Figure 1 illustrates where Montana gets its natural gas.

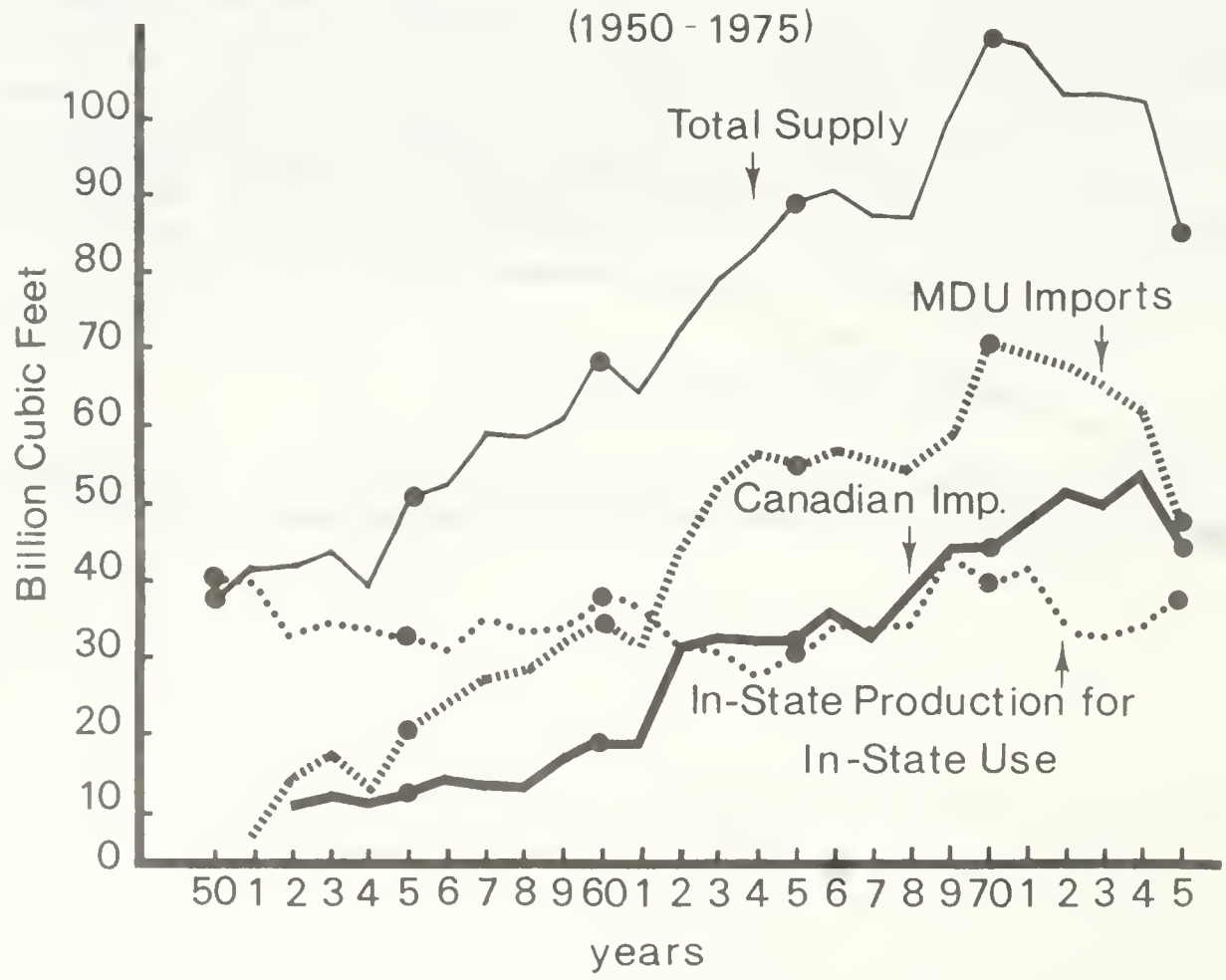

Figure 1: Sources of Montana Natural Gas Supply (1950-1975).

The Problem

The Montana Power Company, serving Western Montana with natural gas, is highly dependent on supplies from Canada. Canada has instituted a policy restricting exports. Under its current permits, Montana Power will no longer be able to receive gas from Canada after 1989.

Montana-Dakota Utilities, serving Eastern Montana, faces a similar natural gas shortage in its service area, but the problem has to do with not being able to secure sufficient natural gas supplies to meet current demand.

The size and timing of Montana's natural gas supply crisis is presented in Tables 2, 3 and 4. The tables are taken from Montana's Natural Gas Supply Crisis, an EQC staff report by Thomas W. Frizzell. The EQC data project a total natural gas shortage of 7.9 billion cubic feet in 1980; 26.2 billion cubic feet in 1985; and 73.9 billion cubic feet in 1990.

Table 2

EQC Worst Case Scenario Projected Western Montana Natural Gas Shortages, 1980-1990 (in billion cubic feet)

	1980	1985	1990
Demand	52.8	54.9	56.9
In-State Supply	22.0	17.0	12.0
Canadian Imports	29.2	25.6	----
SHORTAGE	1.6	12.3	44.9

Table 3

EQC Worst Case Scenario Projected Eastern Montana Natural Gas Shortages, 1980-1990 (in billion cubic feet)

	1980	1985	1990
Demand	20.6	23.8	36.2
Supply	14.3	9.9	7.2
SHORTAGE	6.3	13.9	29.0

Table 4

EQC Worst Case Scenario Projected Montana Natural Gas Shortages, 1980-1990 (in billion cubic feet)

	1980	1985	1990
Western Montana Shortage	1.6	12.3	44.9
Eastern Montana Shortage	6.3	13.9	29.0
TOTAL SHORTAGE	7.9	26.2	73.9

It is important to note that these EQC shortage projections are based on a "worst case" methodology. This means that Montana's natural gas supply has been underestimated and natural gas demand has been overestimated. The EQC projected shortages will not occur and are presented merely to illustrate the "worst case" for the purpose of showing how various alternatives or combinations of alternatives will affect the shortages.

For example, Figure 2 shows that with additional residential and commercial conservation and industrial conversion from natural gas to available alternative

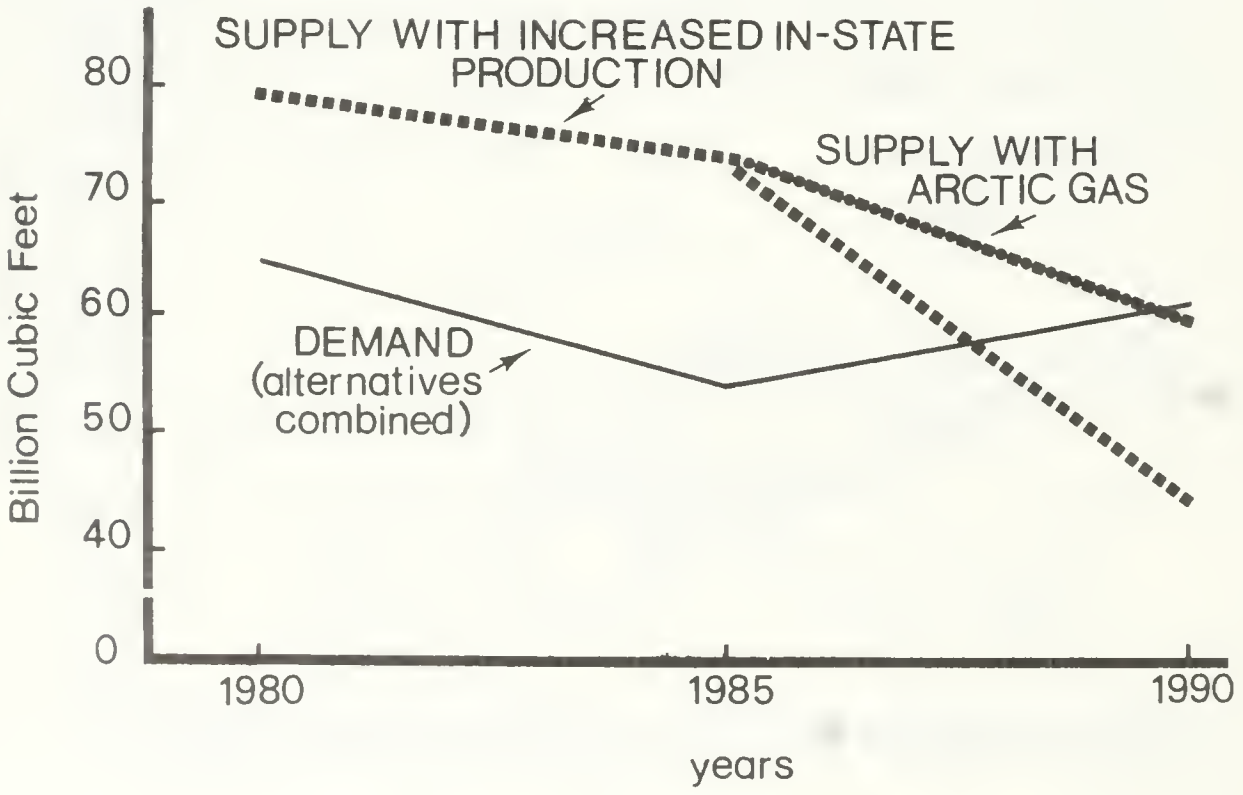

Figure 2: Impact of Least Cost Alternatives on Worst Case Projections.

fuels and with additional increases on the supply of natural gas from in-state production, no shortage occurs prior to 1988. In addition, these projections do not take into account future natural gas price increases which will reduce demand and increase supply even more.

Conservation

The Citizen's Advisory Committee on Energy agrees upon a basic energy philosophy to be discussed later in this report. But the foundation of any sane energy policy must be conservation.

There has never been a more urgent need to use energy wisely and to conserve energy than now. The need is urgent not only because we face drastic curtailments of imported natural gas supplies in the very near future and reductions in crude oil imports in the intermediate future, but also because there is an obvious limitation to nonrenewable sources, and because widespread environmental damage is a result of many current methods of energy production. Energy conservation represents the best way for this country and this state to free itself from the dizzying spiral of more and more energy consumption, leading to calls for more strip mines, more nuclear reactors and more development which in turn require even higher energy use. For the near term, energy consumption will rise in this country and in this state; the real issues are the rate at which it rises and the form of energy used. With rigorous conservation, the increases will be modest, and a balance between a healthy environment and energy development will be achievable. But, if the country gets bored with the idea and drifts back toward its accustomed high growth rate of energy consumption, as it currently shows signs of doing, the increases will not be modest, and there will be no balance.

One of the important aspects of conservation is its relationship to jobs. Organized labor has the most at stake. The current attitude among local organized labor is not clear. It appears that the building and trade unions favor a policy of "more energy equals more jobs". The unions in the service areas of the economy, however, seem more favorably disposed to conservation programs.

Gradual and planned conservation need not disrupt employment. The law requiring more efficient cars will cost no jobs. Requirements for home insulation will actually create them. The greatest menace of all to stable employment is, of course, a return to a very rapid increase in energy consumption. That will inevitably bring once again, as it did in 1973, sudden shortages and massive price increases. The drastic rise in oil prices and the embargo were the major causes of the recent recession in which, a year ago, nearly 9 million Americans were unemployed. Conservation could threaten jobs, if it were done ineptly. But the greater threat is the old American tradition of profligacy.

With a firm commitment, the sort that protects employment rather than jeopardizing it, and raises the standard of living rather than lowering it, this state can keep the near-term annual rise in energy consumption down to an acceptable level. Without any more conservation than at present, the rise in energy use will probably be up to a level that compromises the quality of life we Montanans enjoy. The difference in how quickly energy consumption rises, compounded year by year, is the difference between sound environmental protection and a reckless pursuit of fuel at any cost.

The residential consumer is hurt most by the present lack of a comprehensive state energy policy. Utility rates continue to escalate at an alarming rate with no relief in sight. The plain fact is that consumption costs more than conservation. For example, it costs only a few hundred dollars to insulate a home, and insulation cuts residential energy up to 40 percent; a resident consumer who insulates his home can cut his fuel bill in half. Since figures make the case for conservation from the living room to the industrial plant, why don't Americans, why don't Montanans, get serious about energy conservation? Because nobody at the top has ever asked them to get serious.

Legislators are at the top. You are elected leaders. Armed with the ammunition supplied to you by this Committee as a whole and its four subcommittees, we're asking that Montana develop a comprehensive state energy policy, and that energy conservation measures in particular are implemented and enforced. What we're talking about is very serious; it is no less than the quality of our lives.

Fortunately, an excellent job of creating a state energy conservation plan is now being done by MERDI. They will be bringing recommendations to the Legislature in 1977 and, from reading their initial drafts, we believe their plan to be sound. However, we have a number of specific conservation-oriented priorities and these will be listed later in this report.

Unquestionably, energy conservation is the best solution to the energy problem for many reasons. It will encourage our natural resources to be used at a reasonable rate; it will in most instances provide more employment; and it will greatly ease the demand for more costly energy development. Obviously, there are numerous conservation measures available to us; the point now is to actually make a move to begin using them. Our Committee hopes that the recommendations we have made concerning energy conservation will provide you a firm basis from which to start. In conclusion, we want to remind you of the wisdom of Ben Franklin's succinct adage, "waste not, want not".

The Technology of Coal Gasification

At first glance, the conversion of coal to gas seems simple. Coal, steam, and air (or oxygen) are combined under conditions of high temperature and pressure,

yielding a mixture of combustible gases which can be upgraded to pipeline gas. In reality, a gasification plant consists of a large number of units. For example, the following list of capital equipment (drawn from an economic study by C. F. Braun and Co.), each piece costing at least $8 million, shows the major necessary unit processes.

Unit	Comment
Coal storage and reclaiming.	
Coal preparation.	
Coal feed.	
Gasification and power recovery	The major differences between processes is in the gasification step.
Raw gas quench.	
Shift conversion.	A process which converts carbon monoxide from shift conversion is combined to give methane.
Sour water stripping, ammonia recovery and bio-oxidation.	Sour water stripping refers to removal of CO_2 from the gas steam -- more than half the carbon in coal is lost as CO_2. The other half becomes the pipeline gas. Ammonia may be sold as fertilizer.
Sulfur recovery.	Recovery is quite feasible though sale depends upon demand.
Solids disposal.	A major plant must dispose of over 5,000 tons of ash per day.
Product gas drying.	
Steam and utility systems.	The thermal inefficiency of gasification comes about because of large steam needs.
Plant water systems.	All gasification plants are potential water pollution sources. Most effluents contain phenols, cyanides and various organic compounds. If enough money is spent, the water can be cleaned up.

Oxygen plant.	High BTU gasification plants require oxygen rather than air so that the pipeline gas will be free of nitrogen.

Other facilities necessary include site preparation, electrical distribution, yard piping, buildings, flare systems, tankage, shipping and receiving, sulfur storage, potable and sanitary water, holding ponds and plant roads. Resource use includes coal and water, where the easily remembered approximations are 10 million tons of coal and 10,000 acre feet of water for a year's operation of a standard plant. The DRAVO report to the Montana International Trade Commission (November 15, 1976) for a smaller plant suggests 5,400 acre feet of water and 7.5 million tons of lignite for such a plant in Eastern Montana based on the HYGAS process.

The end result of the technology is to convert coal at a price of $.30 per million BTU to gas at a cost of at least $2.85 per million BTU.

Montana's Alternative

There is a serious national case against coal gasification technology. Briefly, there are strong arguments concerning timing, economics, efficiency and resource use. To borrow a phrase from Canfield, coal gasification may be one of those "future technologies whose time has passed". The case is discussed in more detail in the appendix.

The Montana case on gasification differs significantly from the national one in that one plant could, in theory, run thousands of years on the resource base available in the state. But would there be only one plant? No full-scale gasification plant has been approved any place in the world. Would being first serve as an invitation for more?

Another aspect specific to our situation is the fact that new gasification technologies are being developed rapidly. Although the inefficiency of gasification is inherent in the design process, new technologies will make current designs economically obsolescent. Even necessary industrial development often causes grave social impacts. Placing a technology which is both unproven and soon to be obsolete in a sparsely populated area of Montana invites both social upheaval and ghost town status simultaneously.

CACE's recommended alternative to coal gasification as the solution to Montana's future gas crisis is not a simple one. But, it is based on a distinct philosophy for long-range energy policy and is technically feasible.

We favor:

(1) Diversity and decentralization of energy sources rather than centralized conversion facilities.

(2) State and local control over energy sources rather than federal control.

(3) Simple, "alternative", "intermediate" or "soft" technologies rather than complex technology.

The idea of "soft" technologies has been stated by Amory Lovins (Foreign Affairs, October 1976, pp. 65-96). "Soft is not intended to mean vague, mushy, speculative or ephemeral but rather flexible, resilient, sustainable and benign." Such technologies rely on renewable energy flows, are accessable and are matched in energy quality to end use needs.

A revised look at end use needs is the key. People do not need gas, oil or electricity, but rather comfortable rooms, light, vehicular motion, food, tables and other real things. If Montana's energy needs are seen as end use requirements rather than in terms of a specific form (e.g., gas) of energy, long-range policy decisions are possible.

Our wind, sunshine and water are examples of energy sources capable of yeilding soft technology which can meet real needs.

Although the eastern half of Montana will be able to obtain a higher percentage of its energy from the sun than the west, sunshine can be harvested in all parts of the state. Residential solar space heating is cheaper than electric resistance heating or synthetic natural gas on a life cycle basis. Solar hot water is economically competitive with all current technologies. Both solar technologies will bring more jobs for Montana's craftsmen. Furthermore, ownership of solar energy equipment by both citizens and communities will lead to the recommended decentralization of energy facilities. Water power isn't new in Montana. The "soft technology" pathway might involve the use of small-scale hydro projects as well as current large dams.

Sometime in the distant future, renewable sources of energy will suffice, but the task for the next 50 years is to learn how to use such sources well without vast disruptions in Montana's economy. Fortunately, we have a bridge to that future -- our remaining natural gas and oil and an abundance of coal.

During this bridging period, central coal-fired power plants could continue to operate and a few new centralized stations using more energy-efficient generation systems (e.g., MHD) could be built. However, conversion to coal could best be applied through direct burning via fluidized bed combustion technology now under development. Such systems could serve as partial substitutes for natural gas in residential, commercial and industrial applications. Only about 2.5 billion cubic feet of industrial gas usage, as identified by industrial users, is not substitutable with current technology. That need could be satisfied for many years by remaining natural gas.

The feasibility of following the alternative energy pathway can be shown by careful consideration of the data. We quote heavily from the EQC report "Montana's Natural Gas Supply Crisis" (November 1, 1976) by Thomas W. Frizzell, but projections of the Montana Energy and MHD Research and Development Institute (MERDI), contracted by the Coal Gasification Task Force, reflect the same possibilities.

(1) Usage rates of natural gas are decreasing in Montana. From 1960 to 1970, per capita growth rates for gas averaged 4.10 percent per year. Since 1970, that trend has changed decisively to a negative growth (1.23 percent decrease per year) for gas consumption.

(2) A residential and commercial conservation program could save 5.6 billion cubic feet by 1980, 14.3 billion cubic feet by 1985 and 19 billion cubic feet by 1990. Such a program could include low-cost loans to residential consumers, tax incentives for residential and commercial consumers and new building standards. It has been calculated that a 25 percent tax incentive for solar residential space heating should result in a 0.4 billion cubic feet savings by 1985 and a 1.2 billion cubic feet savings by 1990. Solar water heaters should be able to replace a substantial segment of the 2 billion cubic feet of natural gas now used for hot water and will replace some electrical requirements as well.

(3) Montana industrial consumers already plan to decrease their demand for gas by over 7 billion cubic feet by 1980 by conserving and converting from gas. In addition, industrial gas consumers could further decrease demand mainly by conversion from gas by 4.1 billion cubic feet in 1980, 10.3 billion cubic feet in 1985 and 14.3 billion cubic feet by 1990.

(4) Proven and undiscovered natural gas reserves, if brought into production, could support Montana's 1974 level of consumption (twice that of present production) for at least 23 years, and possibly for a century. Production in Montana has been held low for a number of reasons, but primarily because of the low price paid for gas produced in Montana. Since 1950, Montana gas producers have been paid the lowest average price (or among the lowest) in the United States. With higher prices, Montana could produce substantial quantities of gas in the relatively near future (pre-1985). At $2.00 per thousand cubic feet (approximately what is to be paid for Canadian gas at the border), Montana could produce an estimated additional 13.2 billion cubic feet by 1980, 21.8 billion cubic feet by 1985, and 24.8 billion cubic feet by 1990.

(5) After 1985, Arctic gas could provide Montana with as much as 15 billion cubic feet of natural gas annually. Although such gas would be expensive ($3.00 to $3.50 per thousand cubic feet) and in all likelihood not competitive with technologies such as fluidized bed combustion, the source must be considered.

Such data can be compiled in various ways, but Figure 2 shows that demand should not exceed supply before 1988, even if Arctic gas never arrives (see page 4).

MERDI is currently conducting a study of the demand for natural/synthetic gas in Montana, sponsored by the Federal Energy Administration. The study utilizes a systems dynamics simulation technique and models the interaction of natural gas in the Montana economy. The model can generate any number of alternative "scenarios" by varying input parameters. Research to date has focused on generating a "baseline" future natural/synthetic gas demand and determining the potential effects of residential energy conservation and inter-fuel substitution in the industrial sector. The baseline scenario assumed that current patterns of gas demand will remain unchanged in the future.

Preliminary data from the study indicate that at "reasonable" projected future gas prices, both inter-fuel substitution and conservation will have a very significant impact on demand. These preliminary data indicate that Montana natural gas demand could decrease from today's annual consumption of approximately 78 billion cubic feet per year to 50-55 billion cubic feet in the year 2000. That is, MERDI demand projections are considerably lower than those given by EQC in Figure 1. This decrease is projected to occur in spite of significant growth in Montana's overall economy.

CACE believes that vigorous action by all citizens and by all branches of government can reduce demand on natural gas even more than that predicted. Of course, reserves and usage data must be monitored closely, but we are fortunate in that all current data indicates that there is no need to take the coal gasification step if we take the distinct alternative pathway now.

Specific Legislative Proposals

The Citizen's Advisory Council on Energy recommends legislative action in the following eight areas:

(1) An Energy Advisory Office for the State of Montana: The Committee recommends that a permanent energy advisory office be created as an adjunct of the Governor's Office. The agency would be responsible for the administration of programs provided under the Federal Energy Policy and Conservation Act. It would act as a coordinator of energy affairs for all of the state agencies which have jurisdiction over certain aspects of energy matters. The legislation creating the agency should provide for agency jurisdiction in at least, but not limited to, the following areas:

(a) The agency or office should be required to assign the highest priority to development of an energy contingency or emergency plan to alleviate unreasonable hardships during time of severe energy shortages, such as those that were experienced during the Arab oil embargo or may be experienced in the event the state is unable to develop natural gas reserves to replace the Canadian supply of natural gas at the time when natural gas

deliveries from Canada will be prohibited. In the preparation of the plan, the agency should be required to conduct public hearings on the proposals prior to the promulgation of final regulations thereunder. All other state agencies should be given ample time in which to provide input into the planning for energy emergencies.

(b) The forecasting: The office should provide for a cooperative program between the office, other state agencies, educational institutions and other governmental and quasi governmental institutes dealing with energy problems. The forecasts would be both long- and short-term predictions.

(c) Conservation: A function of the office would be to analyze various types of conservation techniques and programs which will enable the citizens of this state to obtain maximum efficient utilization of its energy resources. In this respect, the legislation should clearly state that energy conservation is the rule and wasteful use of energy is against the policy of the state; and it is the duty of the state to be the leader in the reduction of wasteful energy consumption.

(d) Alternate energy: The legislation should require the office to develop in a reasonable amount of time an affirmative program in research development and demonstration of alternate energy technologies primarily in those forms of energy other than traditional fossil fuels and nuclear resources. Elsewhere in the overall report of the committee, the lack of any coordinated planning in this area is evident. This function of the state energy office would help close the gap between research and practice of "soft" energy technologies.

Such an agency should be required to transmit a report to the Legislature on its activities and recommendations not later than November 1 of even-numbered years.

(2) Life Cycle Cost Analysis: The state should set examples in regard to energy conservation. The concept of life cycle cost analysis is that an analysis of the costs of owning, operating and maintaining a facility over the life of the structure must be made. The application of such costing to all future state buildings should not only minimize consumption of energy in state-operated buildings, but provide an example to the private sector as well. CACE recommends life cycle analysis legislation based on the Florida model.

(3) Tax Incentives for Solar Energy: A number of states have passed legislation providing for tax credits on state income tax related to alternative energy systems. CACE recommends that Montana enact an income tax credit for taxpayers who purchase or construct and install renewable energy (solar, wind and small-scale hydro) conversion and storage systems on their principle residence, farm or commercial building.

(4) Building Codes: The 1975 Montana Legislature passed a bill (H.B. 473) amending Sections 69-2110 and 69-2111 R.C.M. 1947, to change the state building code. That legislation mandated that "the department shall adopt . . . building codes . . . including provisions dealing with . . . conservation of energy." Unfortunately, no date was set by which this regulation must be adopted. A simple amendment setting a date for the promulgation of such rules is recommended. CACE also recommends that the department consider incorporation of ASHRAE 90-75 standards or better in state building codes. Other approaches as suggested by MERDI must be considered too, but there is no reason to delay implementation of standards past December 31, 1977.

(5) Home Weatherization: CACE supports efforts to improve the home weatherization program for low-income households.

(6) Education: For the short run, there should be initiated a serious public information program to convince the public that there is, in fact, an energy shortage, that in a brief time the shortage can reach crisis proportions, and that there are many clear and feasible ways to ameliorate a crisis situation. Such a program should further provide the public with easily understood information on how to implement conservation measures which will save both energy and dollars. For the long run, education is the key. CACE recommends joint legislation which would encourage opportunities for every student in the public schools of the State of Montana to take courses which emphasize (a) principles of ecology; (b) environment of Montana; (c) energy conservation; and (d) private enterprise and the market economy.

(7) Bottle Recycling: Require that all soft drink and beer containers sold in Montana after January 1, 1978, carry a minimum deposit.

(8) Last, but by no means least, CACE recommends no reduction in the percentage of coal severance tax proceeds dedicated to the alternative energy research development and demonstration account.

Appendix A

The National Case Against Coal Gasification

There are serious questions as to whether this nation should choose the energy option of converting coal to synthetic natural gas. The article reprinted below from the August 27, 1976, issue of Science (The Journal of the American Association for the Advancement of Science) examines some of those questions.

Questioning the Synthetic Fuels Option

Why convert coal to gas at all? That is the question being asked by a number of scientists who are skeptical of synthetic fuels and their role in the U.S. energy economy. Elburt Osborne of the Carnegie Institution of Washington, for example, believes that coal-based synthetic fuels cannot be produced in large quantities soon enough to avert shortages of natural gas, perhaps not even before world oil production starts to drop. "We have a terrible problem," he says, "and production of coal-based synthetic fuels before about 1990 will be minuscule," an assessment that is widely agreed to.

Osborne and others point out that the largest and most rapidly available source of "new" natural gas is that now burned under electric utility boilers, which could be liberated for other uses if these power plants were converted to burn coal. If done nationwide, for which the Federal Energy Administration already has the requisite authority, such wholesale conversion would make available about 3.5 trillion cubic feet per year—nearly 20 percent of U.S. gas consumption and an amount that would require 40 large coal gasification plants to produce. The same measures for oil-burning power plants would save about 3 million barrels (1 barrel = 160 liters) of oil a day, a comparable portion of U.S. oil consumption. The conversion would not be easy, since it would, among other things, require doubling U.S. coal production. Nor would it be inexpensive, since many power plants cannot readily switch to coal and some, such as gas turbine generators, cannot burn coal at all. The Texas Railroad Commission estimates that it will cost Texas utilities alone about $18 billion to convert their gas- and oil-fired power plants to coal. Nonetheless, conversion to coal does appear capable of making a far larger contribution to oil and gas supplies over the next 20 years than synthetic fuels.

A second, related question frequently debated is whether it makes economic sense to convert coal to gas. This is largely an argument over energy distribution systems, since the direct use of coal for heat outside the electric utility industry is limited and what was formerly a national distribution system for coal has been essentially dismantled. Two major distribution systems that remain are the electric grid and the gas pipeline network, both expensive, fixed-in-place systems that are potential competitors as carriers of coal-based energy. At present, the pipeline system transports about three times as much energy as the electric grid, not counting the gas ultimately used to generate electricity. But as U.S. gas production declines, the pipelines must either turn to coal gasification, to imports of liquefied natural gas, or face obsolescence.

The gas industry has an obvious interest in keeping the pipelines full. But it also appears to have a valid point in asserting that prolonging the usefulness of the pipeline system will be cheaper than creating whole new distribution systems—whether electric grids, coal slurry pipelines, or rail-barge lines. Given the existing distribution systems, however, is the incremental cost of energy from coal cheaper when delivered in the form of synthetic gas or in the form of electricity?

The answer seems to depend both on the application being considered, since electricity and gas are not directly comparable for many uses, and on what assumptions are made. Gas advocates such as Henry Linden of the Institute of Gas Technology in Chicago point to several factors that favor synthetic fuels: conversion efficiencies are higher, 55 to 70 percent as compared to about 37 percent for power generation; gas plants are expected to operate about 90 percent of the time, whereas power plants operate on an average only about 55 percent of the time in response to the varying demand for electricity; and gas is more cheaply transported. Critics of gasification, on the other hand, argue that the capital costs for these plants will be substantially higher than for an equivalent coal-fired power plant even when equipped with stack gas scrubbing devices and that the greater efficiency with which electricity can be converted to useful work or heat more than compensates for lower generation efficiencies.

Several investigators of the relative economics of coal-based gas and electricity for one widely used application, home heating, have concluded that gasification is a more efficient use of coal than power generation with electric resistance heating, the predominant method at present; conversion of coal to electricity appears to gain a slight advantage, however, if heat pumps are used. Clearly both gas and electricity will be needed, but the economic superiority of gasification has yet to be firmly established.

A third critique of synthetic gas is related to its high cost. At wholesale prices approaching $4 per million Btu, some geologists contend, large additional quantities of natural gas can be extracted from heretofore unexploited sources such as coal seams and brown shale deposits. In most cases the gas-bearing material would have to be hydrofractured—a technique in which water is forced into wells under very high pressure to induce cracks in the surrounding rock—before gas production could begin. But a National Research Council panel recently concluded (*Science*, 13 Feb., p. 549) that these deposits contain more than 500 trillion cubic feet of gas. That is enough, critics argue, to question the wisdom of a commitment to a large gasification industry until more is known about the cost and extent of these resources.—A.L.H.

The significant question asked by Science editor Allen L. Hammond in terms of national policy is "why convert coal to gas at all?" The next few paragraphs look at that question from perspectives different from those of immediate demand and cost which Hammond concentrated upon.

Natural gas may be looked upon as a one-time gift. It was discovered while drilling for something else and was originally thought of as a nuisance, if not a danger. But after discovering it, human ingenuity put that gas to good use and the fact that we will have used up all of the gift within a hundred years of its first use is not a tragedy. This is so because there are available substitutes for every use to which natural gas is now being put. It is true that there is no single substitute which replaces all of the uses of gas. Thus, in this state, Ideal Cement has converted from gas to coal, Hoerner Waldorf will use considerably more wood wastes and homes of the future may use solar-assisted heat pump technology instead of gas, but there is no inherent property of gases (relative to liquids, solids, or energy transmitted by wire) which demands that they be used as fuel.

Non-fuel uses of natural gas (e.g., as a chemical) must be considered when contemplating complete usage of the gift, but here, too, we are fortunate. Natural gas isn't of much use chemically. Petroleum and coal are the resources which can supply us with chemicals for plastics, synthetic fibers, drugs and other consumer items we have grown used to having.

The real argument for coal gasification is that the country has over $100 billion invested in a distribution and end-user equipment system for natural gas (Congressional Record, September 20, 1976, S16179). That is a substantial investment and it might seem prudent to keep the pipelines full and gas hot water heaters in operation.

However, long-range policy must be based not only on the $100 billion already invested, but on the answers to the following questions:

(1) How much investment would be necessary to produce current and projected demands for gas from coal?

(2) Given all uses projected for coal at any reasonable growth rate, how long will the coal last? That is, what lifetime can be expected for a synthetic gas industry?

(3) Given a finite supply of coal, which methods of utilization (e.g., direct combustion, liquefaction, or gasification) will make the supply last for the longest period?

The exact answers to the first two questions require knowledge of future supply, demand and capital costs which is guessable, but by definition, unknowable. Nonetheless, conservative calculations on these questions are instructive.

(1) If we assume current usage (22×10^{12} scf) and best available resources data, gas supplies run out by 2010. We would require 244 gasification plants of normal capacity (250 million scf/day) in order to meet this demand. Current estimates of a billion dollars/plant require a total investment of 244 billion dollars (i.e., over two times what we have already invested in a gas use system). Any increased use of gas would either use up supplies faster and demand additional investment in syngas plants or would be obtained from imports.

(2) Coal reserve estimates are 429 billion tons. How long those reserves will last is dependent upon how it is used (see Question 3 below), but <u>if</u> we choose to use all three of these alternatives (1) convert coal to gas, at current usage, (2) continue with current consumption of petroleum but produce it from coal and (3) use coal for electric power, steel making, etc., at current rates, it would all be gone within a hundred years. Any growth at all in fossil fuel use would either deplete coal reserves faster or increase our imports from other nations.

(3) The answer to the third question requires no projections. Coal gasification is inherently wasteful -- much more so than liquefaction, which is more wasteful to the basic resource than is direct burning. This lack of efficiency stems from the fact that coal is insufficient in hydrogen and that hydrogen must be supplied chemically from steam. Energy loss comes about from heating water to produce steam.

In summary, coal gasification is a wasteful, expensive technology which <u>if highly implemented</u> is doomed by resource conditions to be short lived. We have no national energy policy. If real need, efficient use of natural resources and long-range economics are to be factors in such a policy when it comes, it is highly doubtful if coal gasification will ever become a major factor in future energy choices.

Report of the Legal Subcommittee of CACE

At the CACE meeting in Helena on November 11, 1976, the Legal Sucbommittee presented its analysis of the sixth draft of the Montana International Trade Commission's bill on coal gasification. After that presentation, it was MOVED and ADOPTED that CACE philosophically and specifically oppose the sixth draft of the coal gasification legislation.

The report of the Legal Subcommittee follows and presents a legal analysis of the sixth draft (9/22/76) of the Montana International Trade Commission's proposed legislation entitled "Montana Coal And Related Fuels Protection And Development Act Of 1977" (hereinafter referred to as the "act" or "legislation").

Overview

This legislation provides for the creation of a commission composed of seven members, including the Governor, Lieutenant Governor, Director of the Department of Natural Resources and Conservation of Montana and four "lay members" appointed by the Majority and Minority Party Leaders of both Houses of the Legislature, three of whom must be selected, one each from the sectors of agriculture, labor and utilities; the fourth being an "at large" member. The act would empower the commission to plan for the orderly development and utilization of coal, natural gas and synthetic fuels in the state in order to meet the state's energy needs. It will enjoy a quasi entity status with its own staff, power to prescribe rules and regulations, as well as the power to enter into contracts for the acquisition and development of energy raw materials. The commission also has the power to develop projects for the production of energy independently or in partnership with other public or private concerns. The commission may set rates for the wholesale or retail sale of energy produced at sponsored projects and may utilize existing transmission facilities to deliver energy directly to either existing utilities for resale to their customers and may distribute energy directly to retail customers. The commission may issue bonds to finance the construction costs of its authorized projects. It may institute litigation to determine the validity of any bond issue it authorizes.

Analysis -- Appointment of Members, Their Power and Duties

Section 4(2) of the act permits the abolition of the commission and the transfer of its authority to a corporation or other authority. The act does not establish the method of abolition, but presumably it would require legislative action. This aspect is unclear. It also is unclear whether the corporation which would replace the commission would have the powers of the commission. If so, the conferring of such governmental powers as extensive as they are on private corporations would be ill-advised. Any members of the commission may give a proxy, if he desires, to anyone else who may act in the member's stead at all meetings of the

commission (see Section 7(7)). This power may frustrate clear responsibility for the acts of the individual members. Finally, the act does not impose any reporting or other public answerability responsibilities on the commission. The appointment of "lay members" for the agricultural, labor and utilities sectors may present conflict of interests problems due to the commission's power to enter into contracts with persons, firms or corporations conducting business in these sectors. The act is deficient in this respect in not requiring disqualification of members in such cases. In our opinion, it is not unfair to say, considering the legislation as a whole, if enacted into law, the commission would perhaps become the most autonomous agency in state government. We feel that the remainder of this report will bear that conclusion out.

Analysis -- Powers of the Commission

Reading Sections 4(6), 6(7), 9(2) and 28 together, the commission has the power to acquire mineral rights and water rights through purchase or eminent domain power exercised in accordance with eminent domain statutes. It also has the power to operate mines or other facilities for the extraction of mineral or water resources. While the act does subordinate the commission's eminent domain power to existing legislation, it fails to require the commission to obtain a permit from the State Department of Natural Resources and Conservation before it condemns water rights. Whether it is necessary to give the commission eminent domain powers at all is a policy decision which should be carefully weighed.

Section 6(1) of the act gives the commission the power to assume primary responsibility for all energy-related matters in this state. While the act requires their cooperation with other agencies, it does not subordinate the commission's role in many areas which have been delegated to existing state agencies by prior legislation.

Section 6(16) of the act empowers the commission to fix and collect rates for any product sold by its sponsored projects. It also has the power to dispose of such products to retail consumers. None of these functions are regulated by the Public Service Commission, though in the exercise of these powers the commission would be acting essentially as any other public utility, which is subject to PSC regulation. The rate-making function would not be subject to an independent review which would ensure fair and equitable rates as in the case with utilities. Section 9(3) authorizes the commission to manufacture by-products if it cannot be done in other public or private sectors. This language is nevertheless broad enough to allow the commission to produce other energy products such as electricity and invade service areas exclusively delegated to other activities by prior PSC action. Section 11 authorizes exportation of fuels, gas or other output outside the state when the commission determines that such products are not necessary for in-state consumption. Without independent control of this decision, the commission is free to determine this without further review by other agencies. Section 14 authorizes the commission to issue bonds for project capital requirements, without approval

of any political subdivision of the state. Bonds that may be issued to finance the cost of a public utility type service system for retail customers would not be subject to state regulation. Customarily, public utilities may not raise new capital by bond financing unless approved by an appropriate agency of the state.

Analysis -- Litigation

Section 15 of the act authorizes the commission or any person, firm or corporation to seek judicial review of the validity of any bonds the former may issue. Suits brought by the commission do not need the joinder of an opposing party before the suit may be brought. The proceeding will be in the form of a motion for judgment on the bonds that they will be valid when issued. The motion makes all residents of the state or other persons interested or affected parties to the suit if the commission publishes notice of the suit once a week for two consecutive weeks in a newspaper of general circulation in the capital city of the state.

In our opinion, this latter procedure is unconstitutional under those sections of the State Constitution dealing with judicial power. Suits are in essence subterfuges for the seeking of advisory opinions from courts. Courts in this state are empowered generally to hear only actual cases or controversies, and they do not render advisory opinions. A suit which does not even implead an actual defendent is not a case or controversy over which a court may take jurisdiction. This section of the act could be declared unconstitutional. In the same section and in the last sentence of the first full paragraph on page 38 of the sixth draft of this bill, the court which has "jurisdiction" of any bond validation suit brought under Section 15 must assign the highest priority to the case, taking precedence over all other business of that court. In our opinion, this section's constitutionality is highly doubtful because it violates provisions of the Constitution mandating the separation of governmental powers into three branches -- executive, legislative and judicial. Under the judicial articles of the Constitution, the Montana Supreme Court has supervisory control over the operation of all courts in this state. Included in this power is the power to establish procedures for the operation of the court system. The decision as to which cases have priority belongs to the individual courts initially and ultimately to the Supreme Court.

Analysis -- Legislative Amendment

Under Section 21, the Legislature is powerless to amend the act in any way which will limit or alter the power of the commission to establish, modify or maintain any project or to establish, charge or collect rents, fees or rates if there are any bonds outstanding. While it is true the United States Constitution prohibits a state from impairing the obligation of its contracts, this section would prohibit the Legislature from amending the act in those areas which would not impair existing contracts. As long as bonds are issued, the act may not be amended in these areas. Unworkable provisions in the act could not be removed until the bonded indebtedness is liquidated.

Analysis -- Miscellaneous

Section 28 of the act gives the commission the power on its own determination to withdraw from competitive bidding statutory procedures any contract for property or services when the commission feels such action is warranted. While energy resource allocation is a new and vital concern and many areas may not be appropriate for competitive bidding, the section as worded too broad and vests too much discretion in the commission.

Appendix C

Other Energy Legislation

The following ideas for energy legislation will be given to a new state energy office for study. We favor all of these ideas in principle, but have not studied specific model legislation.

Solar energy equipment warranty
Florida H776, 10-1-76; New York A12685, 5-11-76

Incentives for in-state industrial production of renewable resource harvesting hardware (such as solar panels and windmills) and conservation software.

Common carrier status for Montana Power Company (to allow gas to be carried to industrial users when such users have explored for and discovered their own gas).

Accelerated depreciation for commercial installation of renewable energy sources.

Low cost loans for insulation and renewable energy sources -- financed by utilities, state banks or coal trust funds.

For state purchasing, adopt the value incentive clause, a provision which encourages the contractor to make energy-saving modification for future installments of items supplied. (This strategy saves money and energy at absolutely no cost to the government.)

Coal for export only -- that is, define need in the Major Facility Siting Act as Montana need.